

# Agricultural water management in Bulgaria

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# AGRICULTURAL WATER MANAGEMENT IN BULGARIA

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**Abstract**. This paper analyzes evolution and efficiency of water governance in Bulgarian agriculture during post-communist transition and EU integration. First, it defines the water governance and the scope of analysis. Next, it presents the process of transformation of agricultural water governance embracing all mechanisms and modes – institutional environment, market, private, public, and hybrid. Third, it assesses impacts of newly evolved system of governance on efficiency and sustainability. Finally, it suggests recommendations for improvement of public policies.

**Keywords**: agricultural water governance; market, private, and public modes, Bulgarian agriculture

## 1. Introduction

There has been a fundamental transformation of policing, property rights and organizational structure of agricultural water management in Bulgaria since 1989 (Bacev 2010). That has profound effects on efficiency and sustainability of waters exploitation and agricultural impact on water resources.

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*Second,* it presents the process of transformation of agricultural water governance embracing all mechanisms and modes – institutional environment, market, private, public, and hybrid.

*Third,* it assesses impacts of newly evolved system of governance on efficiency and sustainability.

*Finally,* it suggests recommendations for improvement of public policies.

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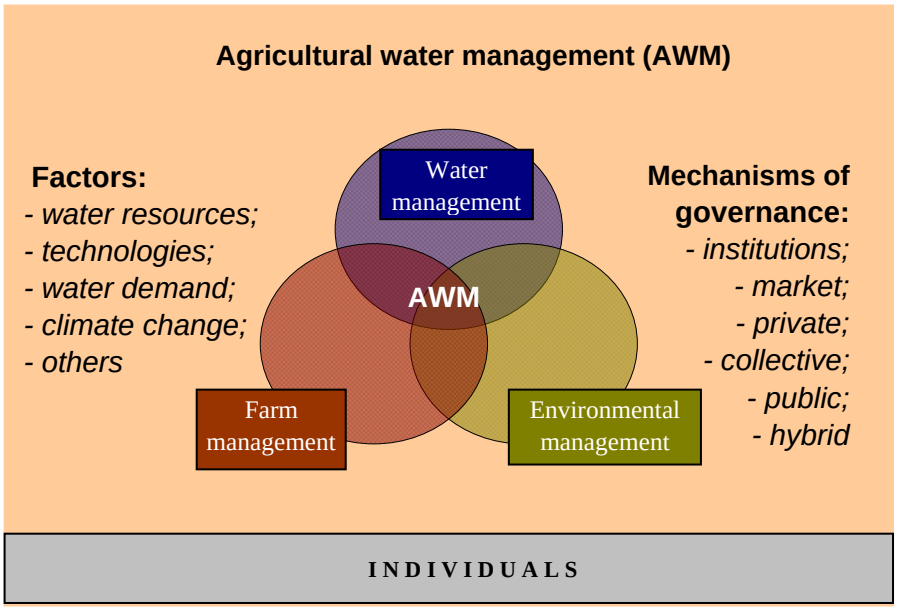
## 2. Definition and scope of analysis

The water governance refers to the specific system of social order regulating relations related to water (suppliers, users, polluters, interest groups etc.) and stimulating appropriate behavior for sustainable exploitation of water resources.

Agricultural water management is studied as integral part of the systems of water management, farm management and environmental management (Figure 1).

**Figure 1. Framework for analysis of agricultural water management**




The analysis embraces all mechanisms and modes of governance affective individual, collective and social behavior including:

– *institutional environment* - distribution of formal and informal property rights and rules, and system(s) of enforcement of these rights and regulations;
– *private modes* (private and collective order) - diverse voluntary initiatives and specially designed contractual and organizational arrangements of private agents such as codes of behavior, contracts, cooperatives, associations, business ventures etc.;
– *market modes* - various decentralized initiatives governed by free market price movements and market competition;

– *public forms* (public order) - different forms of a third-party public (Government, international etc.) intervention in market and private sectors such as public information, regulation, assistance, funding, taxation, control, provision etc;
– *hybrid modes* – some combination of above three.

The analysis takes into account all critical factors affecting specific management choice related to water - natural, institutional, economical, technological, behavioral, international etc.

## 3. Post-communist evolution of agricultural water management

During 1990s most agricultural lands and assets of dominating public farms were privatized, and entire farming activity transferred into newly evolving unregistered farms, cooperatives and agri-firms[1]. For a long-period of time the rights on major recourses (farmland, irrigation facilities) and the diverse environmental rights (usage and preservation of natural resources) were not defined or were badly defined and enforced (Bachev 2010). Most agrarian activities were carried out in less efficient and unsustainable structures[2] with little incentives or capability for effective exploitation and conservation of water infrastructure and resources (Figure 2).

State monopoly Irrigation Systems (IS) was reorganized into a Joint-stock company (owned by Ministry of Agriculture (MA) responsible for the management of state assets, provision of irrigation and drinking water, drainage and flood protection. Union of Water Users was initiated and 176 Water User Associations (WUA) emerged. This collective form was unable to improve efficiency (low incentives, lack of ownership) and deal with monopoly position of 21 semi-autonomous regional branches of IS. Since 2001 the user-wrights on irrigation assets of IS have been freely transferred to newly-registered WUA. Around 70 WUA are formed servicing 30% of the total irrigation area. Expected "boom" in efficiency from collective management of irrigation has not materialized because of semi-monopoly situation (terms, pricing) of regional water suppliers, few incentives for water users to innovate facilities and expand irrigation, and uncompleted privatization of state assets. Evolution of farmers and eco-associations has been hampered by users big number and diversified interests - different size of operation, type of farming, water needs, preferences, age and horizon etc.

[1] Until 1989 farming was carried by small number of large public farms. By 1995 almost 1,8 mil. new farms appeared most of them being small-scale and subsistent. Since 1995 unregistered farms and cooperative decreased 75% and 52% while agri-firms increased 2,4 times.

2 organizations under privatization, liquidation or reorganization; small part-time and subsistence farms; production cooperatives; huge agri-firms based on short-term lease contracts.

**Figure 2. Evolution of agricultural water management in Bulgaria**

| Periods | Public modes | Private modes | Market modes |
|---|---|---|---|
| Transition (1990-2000) | Organizations under privatization and reorganization; Irrigation System Company (IS); Regional branches of IS; Ministry of Agriculture (MA); Fund Irrigation; MA subsidies to IS; Water usage and protection regulations | Cooperatives; Unregistered farms; Agri-firms; Union of Water Users; Water User Associations | Short-term lease contracts; Free (monopoly) pricing |
| Pre EU accession (2001-2006) | Ministry of Environment and Waters (MEW); MA; Executive Environment Agency (EEA); Executive Hydro-melioration Agency (EHMA); Assistance in WUA formation; Free transfer of state irrigation assets to WUA; MA investment in IS; MA subsidies to IS; EU Special Assistance Program for Agrarian and Rural Development (SAPARD); Good agricultural practices; Water user regulations, bans; Eco-monitoring, information, and assessment | Cooperatives; Unregistered farms; Agri-firms; Newly-registered WUA; Private and collective rules for water use; Vertical integration of eco-system services; Interlinked contracts; Environmental NGO's | Free (monopoly) pricing; Organic farming; Eco labeling; Trade with origins, brands, and specific products; Trade with eco-system services; Insurance against droughts and floods |
| EU membership (since 2007) | EU common policies and standards; Cross compliance; NPARD; Long-term public eco-contracts; Eco-training; Free irrigation; Compensation for natural disasters | | |

During transition public eco-policies, regulations, monitoring, and support were inefficient, inconsistent, reactive and sectoral with different agencies responsible for various aspects of water management. Investment Fund Melioration was established and subsidies to IS costs applied (until 2004). However, overall level of public support to agriculture and water sector has been very low. SAPARD introduced measure "Agro-ecology" but it was approved in the end 2006 and few projects actually supported[3].

[3] due to mismanagement SAPARD was suspended by EC (2008) and considerable funding lost.

In last years a number of national programs have been develop[4], system of eco-monitoring and information set up, and mandatory eco-assessment of public programs introduced. Laws, standards and institutions were harmonized with EU which introduced a modern framework for eco-governance including new rules for environment protection, integrated water management, polluter pay principle, and relevant institutions for controlling, monitoring and assessment (EEA, EHMA etc.). Needs to reconcile interests, share and sustain natural resources bring about special governance at watershed, regional, national and transnational scales. However, deformation of public choices by strong private interests, slow and inefficient eco-actions, and poor eco-monitoring has been common.

EU Common (agricultural, water, environmental, rural etc.) policies implementation provides considerable support for farming modernization, infrastructural development, and eco-measures[5]. There is also a mandatory "cross compliance requirement" for receiving public support. That leads to enhancement of sustainability of many farms. There has been a considerable progression in implementation of public measures but it is still far bellow the targets[6]. State also stepped in providing free irrigation in 2007 drought and compensating 2010 flood damages. Due to the poor design, restricting criteria, little awareness, complicated procedures, high related costs etc. most farms can not participate in public schemes[7]. Bad coordination, gaps, ineffective enforcement, and corruption are still typical for public forms[8].

Restructuring of farms continues as most of them apply survival tactics rather than a long-term strategy for improving efficiency (Bachev 2010). What is more, a great portion of subsistent, smaller commercial farms and cooperatives are unable to adapt to evolving market, institutional and natural environment[9]. There have been emerging private modes introducing incentives and possibilities for effective water and integral eco-management (codes of behavior, cooperation, vertical integration, classical or interlinked contracts) profiting from inter-dependent activities such as farming, water use and protection, fishing, recreation, processing, marketing etc. There are

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[4] For Preservation of environment; Development of water sector; Combating climate change; Management of lands and fights against desertification; Agrarian and rural development etc.

[5] Eco-budget of National Plan for Agrarian and Rural Development (NPARD) accounts for 27%.

[6] According to NPARD support to unfavorable mountainous regions will cover 60000 farms and 328000 ha, agri-ecology measures will involve 40000 farms with 110000 ha, area under sustainable use will reach 110000 ha for maintaining biodiversity and 160000 ha for improvement of soils quality, contracts for water quality enhancement will expand to 1000.

[7] E.g. around 16% of all farms receive area based payments and 13% get national top-ups (MAF).

[8] E.g. due to technical and organizational reasons implementation of EU water monitoring programs was delayed and EEA gets no water information from the Academy of Sciences.

[9] market competition, and new EU quality, safety, and eco-standards (Bachev 2010); challenges associated with the climate change (Alexandrov 2008) etc.

good examples for introduction and enforcement of private rules for use and protection of natural resources by farmers and users, and top eco-standards by individual farms or a vertical integrator. In recent years market-driven organic farming and trade with eco-products and services appeared but it is restricted or just a part of marketing strategy rather than a genuine eco-action. Private management is associated with improved environmental stewardship on owned and marketed resources, but less concern to manure and garbage management, over-exploitation of leased and common resources, contamination of soils and waters etc. Free market management of giant and semi-monopoly water supply, servicing and insurance companies usually comes with unfavorable pricing and terms for farmers.

## 4. Impacts on efficiency and sustainability

Newly evolved system of agrarian governance (market and private incentives, smaller size and owner operating nature of farms, etc.) let avoid certain problems of large public enterprises from the past[10]. It has also led to a sharp decline in all crop (except sunflower) and livestock (except goat) productions. The share of water intensive crops like vegetables, rice and maize considerable decreased, while some traditional and more sustainable technologies, varieties and breeds introduced. Large portion of agricultural lands have been left abandoned for a long period of time and the average yields for all major products shrunk to 40-80% of the pre-reform level. All that has relaxed the overall agricultural pressure on environment and water.

There has been more than 21 folds decline in water used in agriculture[11] comparing to 1989 (Table 1). In recent years sector "Agriculture, hunting, forestry and fishery" comprises merely 3,17% of total water use and 0,34% of generated waste waters (NSI). The later contributes to reduction of water stress[12]. Restructuring of farms and agricultural production has been also accompanied with a sharp reduction in irrigated farmland (Figure 3). What is more, a considerable physical distortion of irrigation facilities has taken place affecting 80% of the internal canals (MAF). Furthermore, water losses

[10] over-intensification of production, intensive and inefficient water use, chemical contamination of soils and waters, livestock and manure concentration, uncontrolled erosion (Bachev 2010).

[11] The main sources of water supply in the sector are large dams and rivers. Underground water is a supplementary source while utilization of the sludge from purified waste waters in agriculture and recultivation of degradated lands insignificant. Irrigation water accounts for the major share in total agricultural water use (74,2%).

[12] Depending on year's humidity territory accumulates 9-24 billion $m^3$ water (EEA). In 2006 total water withdrawal was 6559054 out of which 92,8% ground and 7,2% underground water (non fresh water comprise 0,03% of the total). Since 1990 Water Exploitation Index decline considerably from 55% (2d in Europe) to 33%.

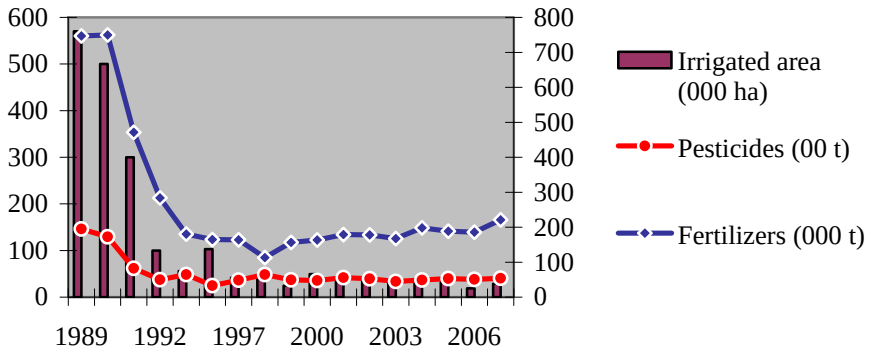
in the irrigation system amount 70% as a result of poorly maintained facilities, low efficiency, and water stealing (Alexandov 2008).

**Table 1. Evolution and agricultural use of water resources in Bulgaria**

| Indicators | 1988-1992 | 1993-1997 | 1998-2002 | 2003-2007 |
|---|---|---|---|---|
| Total water resources ($10^9/m^3$/year) | 21 | 21 | 21 | 21 |
| Water resources per capita ($m^3$/inhabitant/year) | 2427 | 2562 | 2661 | 2748 |
| Total water withdrawal ($10^9/m^3$/year) | 14,04 | na | 8,674 | na |
| Agricultural water withdrawal ($10^9/m^3$/year) | 3,058 | 0,141 | 0,144 | 0,143 |
| Share of agricultural water withdrawal in total (%) | 21,78 | - | 1,66 | - |
| Share of total actual renewable water resources withdrawn by agriculture (%) | 14,36 | 0,66 | 0,68 | 0,67 |
| Area equipped for irrigation (1000 ha) | 1263 | 789 | 622 | 104,6 |
| Share of cultivated area equipped for irrigation (%) | 29,17 | 17,55 | 17,36 | 3,18 |
| Area equipped for irrigation actually irrigated (%) | na | 5,42 | 4,96 | 51,29 |

Source: FAO, AQUASTAT

**Figure 3. Irrigation and chemical application in Bulgarian agriculture**




Source: National Statistical Institute

Negative impact of intensive irrigation on overall erosion and salinization diminished significantly after 1990 (EEA). Erosion has been a major factor contributing to land degradation in Bulgaria. Its progressing level is a result of extreme weather but it has been also adversely affected by dominant agro-techniques, deficiency of anti-erosion measures, uncontrolled deforestation and recultivation of permanent grasslands. Due to ineffective management around one-third of the arable lands are

subjected to wind erosion and 70% to water erosion as total losses varies from 0,2 to 40 t/ha in different years (EEA). Annual losses of earth masses from water erosion are estimated at 145Mt and two-third of it comes from the arable land[13]. Fraction of salinized land doubled after 1989 but it is merely 1,1% of the total farmland (EEA). Widespread application of primitive irrigation techniques, and inappropriate crop choice, rotation and agro-techniques augment inefficiency of water use and local soil erosion.

Decline in irrigation has also had a direct harmful effect on crop yields and structure of rotation. Level of irrigation depends on the humidity in each year, kind of irrigated crops and water prices. Nevertheless, irrigation has not been effectively used to correct inappropriate seasonal and regional distribution of rainfalls, and mitigate effect of climate change[14] on farming and land degradation. Farms little capability for adaptation has resulted in huge crop, livestock and property losses during recent droughts and floods.

There has been a considerable amelioration of the quality of ground and underground waters as a result of unintended decrease of negative impact of agriculture. The total amount of fertilizers and pesticides used has declined considerably and now their per hectare application represents merely 22% and 31% of the 1989 level (Figure 2). Unbalanced N, P and K fertilization is currently applied barely for 37,4%, 3,4% and 1,9% of Utilized Agricultural Area (UAA). This trend diminished drastically pressure on environment and risk of chemical contamination of soils and waters. Nitrate and phosphate content in ground water decreases throughout transition and now only 0,7% of samples exceed Ecological Limit Value (ELV) for nitrate (EEA). Despite improvement, many water eco-systems are at risk cased by agricultural emissions in water and increasing application of chemicals.

In drinking water around 5% of analyses show deviation of nitrates up to 5 times above appropriate level (EEA). The later is mostly restricted to 400 small residential locations but it is also typical for almost 9% of the big water collection zones. Improper use of nitrate fertilizers, inappropriate crop and livestock practices, and non-compliance with specific rules for farming in water supply zones, are responsible for that problem.

Monitoring of water for irrigation shows that in 45% of samples, nitrate concentrations exceed the contamination limit value by 2-20 folds (EEA). Nitrates are also the most common pollutants in underground waters with N levels only slightly exceeding the ecological limit in recent years. Around

[13] soil losses range from 8 t/y for permanent crops to 48 t/y for arable lands (EEA).

[14] According to climate forecasts temperature will continue to increase, rains quantity to decrease, and more extreme events (thunderstorms, floods, droughts, hurricane winds) to occur. By 2030 water availability on more than 50% of the territory will decrease 5-10%, a severe water stress is projected for South-Eastern parts and a medium in some other places (EEA).

country a trend for reduction in pesticides concentration in underground water is reported with occasional cases of triasines over the ELV since 2000.

Nitrate Vulnerable Zones cover 60% of country's territory and around 7% of UAA. The lack of effective manure storage capacity and sewer systems in majority of farms contributes significantly to the persistence of the problem. Only 0,1% of livestock farms possess safe manure-pile sites, around 81% of them use primitive dunghills, and 116 thousands holdings have no facilities at all (MAF). Serious environmental challenge has been also posed by inadequate storage and disposal of expired and prohibited pesticides[15] as 28% of all polluted localities in the country are associated with these dangerous chemicals (EEA). Furthermore, the number of illegal garbage dumps in rural areas has noticeably increased reaching an official figure of 4000, and farms contribute extensively to waste "production" bringing about air, soil and water pollution (EEA).

## 5. Policy recommendations

*First*, better integrate eco- and water (including the neglected underground water) policy in agrarian and development policies as effective design and enforcement of long-term eco-measures get a high priority.

*Second*, completely apply integral approach of soil, water and biodiversity management in planning, funding, management, monitoring, controlling and assessment at all levels with involving all stakeholders in decision-making process. Eco-system services, life-cycle, water accounts, and other modern approaches to be incorporated into program management.

*Third*, improve coordination and efficiency of actions of various public and private agents involved in water and eco-management.

*Forth*, better define, regulate and further privatize (collectivize) property, user, management, trading, discharge etc. rights and assets related to water resources, eco-system services, diverse emissions and wastes.

*Five*, employ greater range of instruments including appropriate pricing, quotas, public funding and insurance, taxing, interlinking etc. to improve efficiency of water use, prevent over-intensification and negative impact on water resources, and support farms adaptation to changing environment.

*Six*, secure adequate water and eco-data collection, monitoring, and independent assessment including agricultural benefits and impacts; waters quality; total costs; water-foot prints; impacts of climate change; existing

[15] Despite progression in management there are still 333 abandoned storehouses in 324 locations for 2050 t pesticides (EEA).

and likely risks etc. Assure mechanisms for timely disclosure and effective communication to decision-makers, stakeholders and public at large.

*Seven,* better adapt CAP instruments to specific Bulgarian conditions supporting farm modernization and adaptation, and irrigation, drainage and flood protection innovations; relaxing EU criteria for semi-market and young farmers; directing funds to prospective (Farm modernization and adaptation, Young farmers) and unsupported (Organic livestock) measures.

*Eight,* employ hybrid modes given coordination, incentives, and control advantages. Public organization and enforcement of most eco-standards is very difficult (especially in huge informal sectors and remote areas). Public support to voluntary initiatives of professional, community and non-governmental organizations (informing, training, assisting, funding), and assistance in cooperation at eco-system, watershed, trans-regional and trans-border levels will be more efficient. Real participation of farmers and stakeholders in priority setting, management, and assessment of public programs and regulations at all levels is to be institutionalized.

*Nine,* improve eco- and water training of farmers, administrators, and public modernizing Agricultural Advisory Service which is to reach all agents via effective methods of education, advice and information suited to their specific needs; set up system of continues training and sharing experiences; include eco and water management and climate change issues; cooperate closely with academic institutions and private organizations.

*Ten,* improve overall institutional environment and public governance perfecting property rights protection and laws and contracts enforcement, combating mismanagement and corruption in public sector, removing restrictions for market, private and collective initiatives etc.

*Eleven,* give more support to understanding agricultural water use and impacts[16], and multidisciplinary research on various aspects, factors and impacts of eco- and water governance. Efforts of researchers in Ecology, Technology, Climatology, Economics, Law, Sociology, Behavioral Sciences are rarely united; most studies focus on individual aspect of sustainability or formal modes; they are restricted to certain form, management level or location; governance of farming is separated from the overall households activities; normative (ideal or model in other countries) rather comparative (between feasible alternatives) approach is employed; and significant social (third-party, correction, transaction) costs ignored.

[16] Agricultural and water research has been severely underfunded for the last 20 years.

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